

Wave impacts on storm walls: Large scale experiments in the Delta flume

Streicher Maximilian, Kortenhaus Andreas and Troch Peter

Department of Civil Engineering, Ghent University, Technologiepark 904, 9052 Gent, Belgium
E-mail: maximilian.streicher@ugent.be

1. Introduction

Coasts of low lying countries, such as The Netherlands, Belgium, UK and Germany are often comprised of a gentle foreshore and shallow waters, followed by a dike and a promenade. At the end of the promenade buildings or storm walls are constructed. In this setting waves can overtop the dike and impact on the storm wall or building. Commonly design guidance for overtopping and overtopped bore impacts for this set-up are developed in relatively deep water conditions, neglecting the dissipation of wave energy due to depth-limited wave breaking on the foreshore. Recently, the reduction in overtopping, the increase in wave periods at the toe have been experimentally studied for shallow water and gentle foreshore conditions. Furthermore, numerical simulation have been performed in the past. Small scale experiments of overtopped wave impacts on walls are conducted and design guidance for overtopped wave impacts on walls for shallow water and gentle foreshore conditions were derived. However, a validation based on large scale experimental data of overtopped wave impacts for this set-up is still missing.

2. WaLoWa objectives

Within the European project 'Wave Loads on Walls' (WaLoWa) model tests in the Delta flume (The Netherlands) have been conducted in March 2017. The project is a cooperation of Ghent University (Belgium), TU Delft (The Netherlands), RWTH Aachen (Germany), University of Bari, University of Florence (Italy) and Flanders Hydraulics Research (Belgium). The project is financed by a grant by Hydralab+ in the framework of the EC Horizon 2020 program. The program provides researchers access to large scale coastal engineering test facilities in Europe. The main objectives are: (a) to study the impact behavior of overtopped waves on vertical structures (b) to study scale effects by comparing the obtained results to small-scale experiments conducted using a similar geometry, (c) to analyze bed profile changes and suspended sediment concentration of the sandy foreshore, (d) to validate numerical models in terms of wave evolution over the foreshore and wave impacts on the wall, (e) to study the overtopped flow formation on the promenade and (f) to apply new measurement techniques for this set-up.

3. Experimental set-up

The scale model geometry is divided into four parts: (1) A sandy foreshore with a slope of 1/35 over a flume length of 80m, made from ~1000m³ of sand, (2) Both a concrete dike with a 1/2 slope and (3) a 2.3m wide promenade are attached to the foreshore, (4) A vertical, 1.6m high wall at the end of the promenade. All values are given in model scale using Froude similarity 1/4.3 and are given more detailed in Streicher et al. (2017). Irregular and Bichromatic waves were tested during the experiments. Waves representing a storm with a 1000 year return period and an additional water level to account for sea level rise result in the tested superstorm conditions. In (part 1) the incoming wave parameters and morphological evolution of the sand bed are measured, in (part 2) the run-up and overtopping are surveyed. In (part 3) the overtopping flow parameters layer thickness and velocity are monitored and in (part 4) the impact forces and pressures on the wall and the flow aeration are measured.

4. Discussion

During the VLIZ talk the large-scale WALOWA model tests, conducted in the largest wave flume facility of the world, will be presented. An outline of the objectives, model construction, test program and measured parameters will be given. With the obtained large-scale data set a detailed study of wave impact processes along the coasts of shallow waters and gentle foreshores is enabled and numerical model validation facilitated. The importance of large-scale physical model testing in coastal engineering will be addressed by highlighting preliminary results. More detailed the pressure distribution induced by a wave impacting the wall will be discussed.

Acknowledgement

The work described in this publication was supported by the European Community's Horizon 2020 Research and Innovation Programme through the grant to HYDRALAB-PLUS, Contract no. 654110.

Reference

Streicher, M., Kortenhaus, A., Altomare, C., Gruwez, V., Hofland, B., Chen, X., Marinov, K., Scheres, B., Schüttrumpf H., Hirt, M., Cappietti, L., Esposito, A., Saponieri, A., Valentini, N., Tripepi, G., Pasquali, D., Di Risio, M., Aristodemo, F., Damiani, L., Willems., M., Vanneste D., Suzuki, T., Klein Breteler, M., Kaste, D. (2017). "WALOWA (Wave Loads on Walls) – Large-scale experiments in the Deltel Flume". Proceedings of the 8th SCACR conference 3rd – 6th October, Santander (Spain).

Keywords: coastal engineering; storm walls; overtopping; wave impacts; large-scale experiments

BOOK OF ABSTRACTS



VLIZ SPECIAL PUBLICATION 80



BOOK OF ABSTRACTS

VLIZ MARINE SCIENCE DAY

MEC STAF VERSLUYS, BREDENE
21 MARCH 2018

VLIZ SPECIAL PUBLICATION 80

This publication should be quoted as follows:

Jan Mees and Jan Seys (Eds). 2018. Book of abstracts – VLIZ Marine Science Day. Bredene, Belgium, 21 March 2018. VLIZ Special Publication 80. Vlaams Instituut voor de Zee – Flanders Marine Institute (VLIZ): Oostende, Belgium. 142 + ix p.

Vlaams Instituut voor de Zee (VLIZ) – Flanders Marine Institute
InnovOcean site, Wandelaarkaai 7, 8400 Oostende, Belgium
Tel. +32-(0)59-34 21 30 – Fax +32-(0)59-34 21 31
E-mail: info@vliz.be – Website: <http://www.vliz.be>

Photo cover: VLIZ

The abstracts in this book are published on the basis of the information submitted by the respective authors. The publisher and editors cannot be held responsible for errors or any consequences arising from the use of information contained in this book of abstracts. Reproduction is authorized, provided that appropriate mention is made of the source.

ISSN 1377-0950

PREFACE

This is the 'Book of Abstracts' of the 18th edition of the VLIZ Marine Science Day, a one-day event that was organised on 21 March 2018 in the MEC Staf Versluys in Bredene.

This annual event has become more and more successful over the years. With almost 400 participants and more than 100 scientific contributions, it is fair to say that it is the place to be for Flemish marine researchers and for the end-users of their research. It is an important networking opportunity, where scientists can meet and interact with their peers, learn from each other, build their personal professional network and establish links for collaborative and interdisciplinary research.

Marine scientists from all Flemish universities and scientific institutes – and representing all marine science disciplines – have contributed to this volume. The book thus illustrates the diversity, quality and relevance of the marine sciences in Flanders (and Belgium): it provides a beautiful and comprehensive snapshot of the state-of-the-art of marine scientific research in Flanders.

Pre-doc and post-doc scientists present their research in an exciting way and communicate their fascinating science – and its importance to society – to the wider public. We thus hope to demonstrate the excellence of Flemish marine science and to increase its national and international visibility.

The volume of research that is presented here holds a great promise for the future. It shows that marine science is a very lively discipline in Flanders, and that a new generation stands ready to address the grand challenges and opportunities that our seas and oceans represent.

For the second year, the Brilliant Marine Research Ideas are awarded, an initiative sponsored through the philanthropy scheme of VLIZ. We are proud to announce that last year's winners present their results here at the VLIZ Marine Science Day.

I want to congratulate all participants with their contributions, and I invite them all to become members of VLIZ and to actively participate in our events and activities in the future.

Bredene, 21 March 2018

Prof. Dr Jan Mees

General Director VLIZ

TABLE OF CONTENTS

Preface	iv
Table of Contents	Error! Bookmark not defined.
Keynote presentations	
Huvenne Veerle A.i. - Towards a better understanding of our marine environment: of habitats, maps and engineering	2
Vandegheuchte Michiel <i>et al.</i> - The VLIZ Research Framework.....	3
Meet The Company	
Verschraegen Frank - DEMA: Creating land for the future	5
Vandendriessche Sofie - From farm to fork, from sea to spoon	6
Mertens Tina <i>et al.</i> - Vacancies @ VLIZ.....	7
Oral presentations: pre-doc level	
Balitsky Philip <i>et al.</i> - Analysis of the power output and the <i>far-field</i> effects of a 50-WEC farm using a novel coupling technique	9
De Raedt Jonathan <i>et al.</i> - The effect of connectivity on productivity and diversity in micro-algae communities.....	11
De Winter Wim <i>et al.</i> - Prize papers as new sources for maritime historical research: The circulation of knowledge on the sea	12
Gaulier Camille <i>et al.</i> - The geochemical behaviour of trace metals in the surface water of the Belgian Coastal Zone	13
Huyghe Filip <i>et al.</i> - Reef health influences self-recruitment in a meta-population of Skunk Clownfish (<i>Amphiprion akallopisos</i>) in the Indian Ocean connected through larval dispersal	14
Huysman Steve <i>et al.</i> - Have plasticizers already reached our marine environment?	15
Gruwez Vincent <i>et al.</i> - Towards an improved numerical modelling methodology for wave overtopping on a dike with a very shallow foreshore	16
Koch Josef <i>et al.</i> - Investigating life history toxicity in the copepod <i>Nitocra spinipes</i> by means of a Dynamic Energy Budget model	18
Maes Rafael <i>et al.</i> - Does a possibility exist to optimize the fatty acid composition of FAME's in order to decrease the concentration of NO _x and PM in the exhaust gas composition?	19
Mavraki Ninon <i>et al.</i> - Food web structure of fouling communities along the ecological zonation of artificial hard substrates in a North Sea offshore wind farm	20
Mestdagh Sebastiaan <i>et al.</i> - Spatio-temporal variation in contribution of biodiversity and environment to benthic ecosystem functioning in the Scheldt estuary	21
Moeris Samuel <i>et al.</i> - Ecotoxicity testing of environmentally realistic contaminant mixtures using passive samplers: what can we learn from repeating toxicity tests over an extended period of time?	22
Nohe Anja <i>et al.</i> - The impact of decades of human-induced environmental change on phytoplankton communities in the Belgian part of the North Sea	23
Stock Willem <i>et al.</i> - The BIO-Tide project: The role of microbial biodiversity in the functioning of marine tidal flat sediments	24

Streicher Maximilian <i>et al.</i> - Wave impacts on storm walls: Large scale experiments in the Delta flume	25
Strypsteen Glenn <i>et al.</i> - Dynamic sand: Towards a resilient Belgian coast	27
Van De Velde Sebastiaan <i>et al.</i> - The evolution of burrowing fauna triggered a low-oxygen ocean and global warming	28
Vanermen Nicolas <i>et al.</i> - Seabird displacement at offshore wind farms: Effect versus impact	29
Vercauteren Maaike <i>et al.</i> - Development of an innovative two-chamber skin explant model for marine fish	30
Westmeijer George <i>et al.</i> - Habitat suitability modelling of macroalgae with a mechanistic approach.....	31
Oral presentations: post-doc level	
De Witte Bavo <i>et al.</i> - A novel approach to model 4 decades of marine chemical data	33
Dehnhard Nina <i>et al.</i> - Foraging distribution, habitat preferences and diet of Antarctic petrels, cape petrels and southern fulmars – inter-specific overlap as a consequence of high environmental variability?.....	34
Nimmegeers Sofie <i>et al.</i> - Are we approaching MSY in 2020? Focus on commercial fish stocks important to Belgian fisheries	35
Sturaro Nicolas <i>et al.</i> - Ecological effects of marine protected areas: the case of seagrass macrofaunal assemblages	36
Van Hoey Gert <i>et al.</i> - Hope for recovery of the soft-bottom ecosystem after cessation of fishery disturbance?	37
Demo presentations	
Dauwe Steven <i>et al.</i> - The Compendium for Coast and Sea	39
De Baere Kris <i>et al.</i> - Maritime research with a green nod at Antwerp Maritime Academy	40
De Moor Willem - JPI Oceans - The Joint Programming Initiative Healthy and Productive Seas and Oceans	41
Debusschere Elisabeth <i>et al.</i> - Knock knock, who's there?	43
Dekeyzer Stefanie <i>et al.</i> - Building an online and interactive scientific data explorer for LifeWatch observatory data	44
Deprez Tim <i>et al.</i> - Arduino in Marine Sciences: building and controlling sensors for marine research projects	45
Knaeps Els - VITO Remote Sensing	46
Lust Heike <i>et al.</i> - The VLIZ Library: Look no further.....	47
Martin Miguez Belén <i>et al.</i> - EMODnet: your gateway to marine data in Europe.....	48
Mascart Thibaud <i>et al.</i> - MarineTraining.eu – Towards tomorrow's new blue challenges in Europe's Marine and Maritime education landscape	49
Mortelmans Jonas <i>et al.</i> - From sample to library: The ZooSCAN pathway unraveled	50
Rappé Karen <i>et al.</i> - VLIZ Philanthropy: The sea as a good cause	51
Seys Jan <i>et al.</i> - VLIZ information stand and social media.....	52
Tyberghein Lennert <i>et al.</i> - ScheldeMonitor, the online data and information hub for the Scheldt Estuary.....	53
Vandepitte Leen <i>et al.</i> - World Register of Marine Species	54
Vandorpe Thomas <i>et al.</i> - Marine Robotics @ VLIZ.....	55

Informative posters

Chaerle Peter - BCCM/DCG - The reliable source and destination for all your microalgae	57
Deprez Tim <i>et al.</i> - Join the International Master of Science in Marine Biological Resources (IMBRSea) today!.....	58
Knockaert Carolien <i>et al.</i> - Marine Data Archeology: Bringing historical data back alive.....	59
Muñiz Piniella Angel - European Marine Board	60
Naudts Lieven <i>et al.</i> - NewRV: A new multidisciplinary research vessel to replace the RV A962 Belgica	61
Souza Dias Francisco <i>et al.</i> - MarineRegions.org – a world reference for Maritime Boundaries	62
Van Puyvelde Karolien - MSc in Marine and Lacustrine Science and Management	63
Verstraeten Tim <i>et al.</i> - ASSEMBLE-Plus: promoting access to the EMBRC marine stations and laboratories	64

Posters in competition

Arboleda Chavez Carlos Emilio <i>et al.</i> - Development of a numerical wave flume for the study of scour protection around offshore monopile foundations under waves and currents.....	66
Asselman Jana <i>et al.</i> - Molecular technologies in the marine environment: Assessing the status of marine ecosystems with just four letters ACTG.....	68
Baetens Katrijn <i>et al.</i> - Water and sediment circulation in the ports of Zeebrugge and Ostend	69
Barrios Trullols Africa - Searching for carbon neutrality for charcoal and pole production in Matang Mangrove Forest Reserve, Malaysia	70
Belliard Jean-Philippe <i>et al.</i> - Diversity in tidal network morphology: exploring the potential role of the marsh geomorphic setting	71
Bodur Yasemin <i>et al.</i> - Disturbance effects from the 79N Glacier (Northeast Greenland) on local benthos ecosystem functions: correlating data from then and now.....	72
Brand Evelien <i>et al.</i> - How waves and suspended sediment affect the beach that we see	73
Breine Naomi <i>et al.</i> - Small scale flatfish nursery differences in the southern Bight of the North Sea	74
Camargo Carolina <i>et al.</i> - Importance of quality control for sea level observations	75
Dahdouh-Guebas Farid <i>et al.</i> - The Erasmus Mundus Masters Course in Tropical Biodiversity and Ecosystems - TROPIMUNDO.....	77
De Blok Reinhoud <i>et al.</i> - Phytoplankton dynamics in the Belgian coastal zone monitored with a Cytosense flowcytometer	79
De Boodt Charlotte <i>et al.</i> - Can chitinozoan biostratigraphy of the Maquoketa Group (Illinois Basin, USA) help unravel the order of events leading up to the Late Ordovician mass extinction?.....	80
De Mesel Ilse <i>et al.</i> - Life among the stones: The gravel beds in the Belgian part of the North Sea	81
Decorte Griet <i>et al.</i> - Dynamic response of a floating offshore wind turbine structure to extreme wave loading in nonlinear, directional seas.	82
Devolder Brecht <i>et al.</i> - A general overview of OpenFOAM as an open source numerical wave tank.....	84
El Adak Yousri <i>et al.</i> - Let's integrate the voice of citizens into decision analysis - prioritizing social-economic and social-ecological objectives within mangrove management in Johor, Malaysia.....	86
Escobar Ramos Juan Sebastian <i>et al.</i> - Hydrodynamics and sediments of the Bay of Buenaventura, Colombia – A 2D modeling study.....	87
Everaert Gert <i>et al.</i> - Data recycling. How to get new information out of existing data?	88

Fang Xiaoyu - Spatial and seasonal variability in ecosystem processes: quantifying the contribution of macrofauna to particle mixing and burrow ventilation in estuarine soft sediments	89
Guden Rodgee Mae <i>et al.</i> - Living apart-together: Microhabitat differentiation of cryptic nematode species in a saltmarsh habitat	90
Haelters Jan <i>et al.</i> - Wind-driven influx of Atlantic water in the southern North Sea	91
Hillewaert Hans - <i>Macropodia</i> , an underrated spider crab genus in the Belgian part of the North Sea	92
Ibanez Sanz Maria <i>et al.</i> - Mud: Large scale sediment transport processes from a very small scale physics perspective	93
Ivanov Evgeny <i>et al.</i> - Application of two way nesting model to upscale sediment processes of the Southern Bight of the North Sea: full model validation.	94
Jossart Quentin <i>et al.</i> - Depth-differentiation <i>versus</i> depth-refugia hypotheses: a case study in two Southern Ocean sea stars	95
Kassi Ahon Jean-Baptiste <i>et al.</i> - Seasonal evaluation of the constituents and approximate color of water at the mouth of the Sassandra river (western Cote d'Ivoire)	96
Kerckhof Francis <i>et al.</i> - Invading European shores: First European record of the acorn barnacle <i>Balanus glandula</i> Darwin, 1854	97
Lachs Liam <i>et al.</i> - Island resort runoff threatens reef ecosystems: An isotopic assessment of the extent and impact of sewage-derived nitrogen across Redang Island, Terengganu, Peninsular Malaysia.....	98
Le Bourg Baptiste <i>et al.</i> - Effects of fluid preservation on sea star stable isotope composition: How useful can museum collections be for trophic ecology studies?.....	99
McCarthy Morgan <i>et al.</i> - Amplifying DNA from dugong skulls, what will it yield for future applications?.....	100
Missiaen Tina <i>et al.</i> - Drowned but not forgotten- The search for the old Ostend	101
Mohamed Ahmed Hussein - Mapping of seagrass beds and cover change analysis using Landsat imageries, Gazi bay Kenya.....	102
Moreels Nele <i>et al.</i> - Abundance of giant clams (<i>Tridacna sp.</i>) on protected versus unprotected coral reefs in the Western Indian Ocean	103
Nicholson Ella Louise <i>et al.</i> - Genetic diversity of the Indian prawn (<i>Fenneropenaeus indicus</i>) along the coastline of Madagascar	104
Peignot Quentin <i>et al.</i> - $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ measurements in Antarctic Notothenioid fishes: variation of their trophic ecology.	105
Poti Meenkshi <i>et al.</i> - Local community perceptions on sea turtle egg consumption in Redang Island, Malaysia	106
Pribadi Ajie Brama Krishna <i>et al.</i> - Cultivating mussels in the Belgian North Sea	107
Ratsimbazafy Hajaniaina <i>et al.</i> - Genesis & future of Marine Protected Areas in Madagascar: A Delphi-based approach to inform sustainable management	108
Richard Niyomugabo <i>et al.</i> - Assessment of stakeholders' perceptions and expectations regarding alternative livelihoods in support of sustainable mangrove management in Senegal	109
Rumes Bob <i>et al.</i> - Does offshore wind farm construction in the Southern North Sea lead to an increase in observed harbour porpoise strandings?	110
Scheers Tina <i>et al.</i> - Abundance and length-weight relationship of commercial demersal fish species in the Belgian North Sea	111
Semmouri Ilias <i>et al.</i> - Effects of temperature on the transcriptome of the marine copepod <i>Temora longicornis</i>	112
Toussaint Elise - How is benthic biogeochemical cycling affected by sediment fining arising from human activities?	113

Van Caster Nathalie <i>et al.</i> - Connectivity of the big blue octopus (<i>Octopus cyanea</i> , Gray 1849) between the eastern and western coast of Madagascar	114
Van Nieuwenhove Annelore H.M. <i>et al.</i> - Genetic population structure and connectivity of the big blue octopus, <i>Octopus cyanea</i> (Gray, 1849), in the Western Indian Ocean.....	115
Van Putte Niels <i>et al.</i> - Improving groundwater dynamics: A key factor for successful tidal marsh restoration?	116
Van Zwijsvoorde Thibaut <i>et al.</i> - Inland vessels at sea as efficient hinterland connection for Belgian Seaports: Current practice and future developments	117
Vandebeek Ine <i>et al.</i> - Numerical modelling of changing beach morphodynamics and wave-interactions with a dike for very shallow foreshores	118
Vanhove Brecht <i>et al.</i> - Ingestion, accumulation and trophic transfer of microplastics in the benthos of the Belgian part of the North Sea and Westerschelde estuary.....	120
Vanryckeghem Francis <i>et al.</i> - Targeted screening by Orbitrap HRMS reveals the occurrence of pharmaceuticals, personal care products and pesticides in the Belgian Part of the North Sea	121
Vansteenbrugge Lies <i>et al.</i> - From data to quota: How are the Belgian quota determined?	122
Vasarmidis Panagiotis <i>et al.</i> - Prediction of wave field generation performance for the new Coastal and Ocean Basin (COB) in Belgium.....	123
Verao Fernandez Gael <i>et al.</i> - Validation of a coupling methodology for numerical modelling of near and far field effects of Wave Energy Converter arrays using the MILDwave and NEMOH models, based on the WECwakes experimental database	124
Vlaminck Ellen <i>et al.</i> - Macrobenthos-mediated nutrient cycling in offshore wind farm environments under future ocean climate settings	126
Voet Helena <i>et al.</i> - Investigating the combined effects of climate change on ecophysiological response of offshore wind farm fouling fauna.....	127
Wu Minghao <i>et al.</i> - Large-scale modelling of scour protection around wind turbine monopile foundations	128
VLIZ Philanthropy Brilliant Marine Research Ideas 2017	
Burdorf Laurine <i>et al.</i> - Who are the cable bacteria?.....	130
Heindler Franz Maximilian <i>et al.</i> - Ancient Marine Metabarcoding – A new approach of stomach and microbiome analysis for historical fish.....	131
Meskens Raf <i>et al.</i> - Development of a test platform for anti-fouling coatings.	132
Van Acker Emmanuel <i>et al.</i> - Do marine aerosols improve human health?.....	133
VLIZ Communication Award 2017	
De Clercq Maikel <i>et al.</i> - Drowned landscapes of the Belgian Continental Shelf	135
VLIZ Master Thesis Awards 2017	
Dekoninck Michiel - Roman salt production in the <i>civitas Menapiorum</i> . A study of the implemented technological process on the salt production sites through the analysis of the briquetage from the region Zeebrugge-Dudzele.....	137
Lodewijks Emily <i>et al.</i> - Potential human health effects of phycotoxins in marine bioaerosols	139
VLIZ North Sea Award 2017	
Goedknecht Anouk - Pacific oysters and parasites: Species invasions and their impact on parasite-host interactions.....	142